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MORTALITY DIFFERENCES AMONG THE INDIGENOUS POPULATIONS OF FRENCH AND BRITISH ORIGIN, AND THE ABORIGINAL POPULATION OF CANADA, 1950-52 TO 1970-72

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ABSTRACT

MORTALITY DIFFERENCES AMONG THE INDIGENOUS POPULATIONS OF FRENCH AND BRITISH ORIGIN, AND THE ABORIGINAL POPULATION OF CANADA, 1950-52 TO 1970-72

Mortality differentials reflect the social and economic conditions of groups in society. In this analysis the relationship between ethnic origin and mortality is investigated from the point of view of the mortality assimilation hypothesis and the minority group status effect. A logit regression methodology is used to study the conditional odds of dying among the French, the British and the Aboriginal (Indians, Inuit, Metis and Eskimos) indigenous populations of Canada over the three census periods 1951 to 1971. Although there has been a significant downward trend in the death rates of all three subpopulations since 1951, substantial differences persist. Moreover, the pace of mortality decline over time varies across the three ethnic groups. In the twenty-year interval between 1951 and 1971, the Aboriginal People have experienced spectacular gains in reducing their overall death rates. In comparative terms, however, their mortality rates have always exceeded those of the French and the British ethnic groups. The former group has shown intermediate levels of mortality while the latter has demonstrated the most advantaged position in the face of death. The multivariate analysis provides strong support for the minority status effect which is taken to suggest that the roots of inequalities in survival probabilities are a result of disparities found in the stratification system of Canadian society. The assimilation thesis received some support in that the general pattern over time is one of declining mortality along with some narrowing of the differences; however, complete convergences have failed to occur. Examination of four broad categories of cause of death (neoplasms, cardiovascular, accidents-violence and other) tend to confirm the findings pertaining to general mortality.

INTRODUCTION

Mortality differentials are of interest to sociologists because differences in death rates are known to be partly a function of social and economic inequality. Unfortunately, we have limited knowledge on this relationship as it pertains to the mortality experience of minority groups in North America. Data are available in the United States concerning the black population (e.g. Preston et al., 1972; Kitagawa and Hauser, 1973; Markides, 1983), and to a lesser extent Hispanics and Native Americans (e.g., Markides, 1983; Rosenweike, 1983), but for the most part, other racial and ethnic minorities have not received the same degree of attention by sociologists. In Canada, the amount of documentation on ethnic origin and mortality is lacking to an even greater extent. With the exception of a few isolated case studies focusing on certain groups in specific regions, we know little about the relationship between sociocultural background and mortality. A second feature of the problem is the general omission of multivariate procedures to evaluate competing hypotheses in order to explain differences in the death rates.

This study investigates the mortality differences, general and cause specific, of the French, British and Aboriginal indigenous populations of Canada over the 20-year interval 1951 to 1971 by employing a multivariate methodology for the analysis of the relative risk of death. The sociological framework of this investigation conforms to the view that the mortality levels of ethnic and racial minorities reflect their relative positions in the stratification system of society. It supports the thesis that the lower the socioeconomic standing of the group, the lower their life chances, and correspondingly, the higher their relative mortality levels.

A dominant feature of Canadian society is the increasing cultural heterogeneity of its population. It has been suggested by John Porter (1965),

and by others (Clement, 1975; Goldstein and Bienvenue, 1980; Forcese, 1980; Curtis and Scott, 1979), that one of the latent consequences of a multicultural society is the maintenance and persistence of group inequality along racial and ethnic dimensions. Historical and contemporary evidence suggests that the balance of power in the social, political and economic structures of Canadian society has leaned in favour of the British Anglo-Saxon group and less so for other ethnic origins such as the French, and in particular, the Native Peoples (Aboriginals).

Although empirical links between ethnic group membership and socioeconomic position have been established, scholars have failed to focus on the relationship between ethnic origin and mortality in the context of the sociology of race and ethnic relations. In fact, some of the leading texts in the field fail to treat this as an important dimension of racial and ethnic groups in society (e.g., Simpson and Yinger, 1972; Vander Zanden, 1983). Also, social demography has not provided the needed theoretical framework for the analysis of minority group mortality in the same way that it has been successful in generating work concerning minority group status and other demographic phenomena such as fertility (Goldscheider and Uhlerberg, 1969; Bean and Friesbie, 1978).

Development of Hypotheses

The Mortality Assimilation Model

Social demographic studies have either implicitly or explicitly adopted the assimilation model of human action in research concerning the demography of racial and ethnic groups (Bean and Friesbie, 1978). This model posits that particular features of a group's culture are responsible for creating social demographic differences. This approach has received wide application in the context of ethnic and minority fertility patterns in North America (Goldscheider

and Uhlenberg, 1969; Trovato, 1981). Variations are assumed to reflect a "culture lag", and in the course of time, the differences will eventually converge due to the assimilative forces of modernization and industrialization prevailing in the larger society. Although the concept of assimilation has received a variety of meanings by different authors (e.g., Park, 1949; Gordon, 1964), in the strictest sense, assimilation may be conceived to imply the loss of cultural distinctiveness of a given group and its fusion with the dominant society (Vander Zenden, 1983; Simpson and Yinger, 1972). In this study assimilation is treated in a different way. Mortality assimilation is considered as a process whereby in the passage of time the relatively higher mortality level of the minority eventually declines and converges with that of the majority population. The causal dynamics responsible for the fusion of mortality levels are assumed to be the result of both outochthonous and exogenous factors to the ethnic or racial minority. Rather than focussing on the loss of culture through the process of fusion, this variant of the assimilation model of action emphasizes the group's gains in mortality reduction as a function of structural assimilation (e.g., socioeconomic and political gains) and changes in life style habits and health behaviour which follow structural assimilation.

The theoretical roots of the mortality assimilation hypothesis originate in the classic statements of demographic and epidemiological transitions (Omran, 1971; Goldscheider, 1971; McKeown et al., 1972; Coale, 1975; Abu-Lughod, 1964). The proponents of a traditional view of demographic transition suggest that as societies progress from a predominantly agrarian social structure to an urban complex social system mortality declines to historically low levels. The differentials in this final stage of transition also tend to narrow and become minimal because, presumably, the quality of life and accessibility to good

health care are maximized by the advanced social organization of society (Goldscheider, 1971). Also, the modern society is assumed to create a general homogenization of values, norms and life styles relating to health behaviour tending to further minimize mortality differentials.

Empirically, the evidence seems to provide partial support for the transition model. The secular pattern of mortality in the modern world is one of low and declining death rates, but in opposition to the traditional demographic transition formulation, evidence suggests that societies have not reached a stage of full convergence. This has led Goldscheider (1971:265) to say that "Despite the dramatic mortality declines ... accompanying industrialization, and health and welfare planning, no country has eliminated ... mortality differences and few have been successful in reducing mortality discrepancies". The review by Antonovsky (1967) concerning the persistence of a class gradient in mortality confirms Goldscheider's assertion. More recent evaluations leave little question on the prevalence of mortality inequalities in the advanced societies (Kitagawa, 1977; Stockwell et al., 1978; Powell, 1978; Fein, 1977).

North American evidence demonstrates that there are persisting differences in mortality among racial and ethnic groups (Bradshaw and Fonner, 1978; Markides, 1983; Crimmins,1981; Roy, 1975). Given this fact, discrepancies in subgroup survival probabilities are to be expected regardless of the fact that Canada is well in its final stage of demographic and epidemiologic transitions.

Omran's (1971) epidemiological model predicts that if differences in survival exist, they ought to manifest themselves in the cause of death structure of populations. Given the improvements in life expectancy in contemporary society the major causes of death tend to be life style related (such as cardiovascular complications, accidents and violence), and degenerative

diseases, as opposed to infectious and parasitic causes (McKeown et al., 1972; Omran, 1971). To the extent that a minority lags socioeconomically in relation to the larger society, this general pattern may vary. The greater the social and economic segregation of a group, the higher its death rate, and perhaps the greater the relative importance of infectious and parasitic causes of death. Considering these possibilities, one might ask whether mortality differences, general and cause specific, continue to exist, and if so, whether or not these differences are disappearing.

The Minority Status Hypothesis of Mortality

A complementary explanation to the assimilation thesis is the minority status hypothesis; it predicts that the higher death rates of disadvantaged racial or ethnic minorities is a function of their relative deprivation. While its complementarity with the assimilationist explanation is clear, it is also an independent hypothesis. Although the time trend in the death rate of the minority may be a declining one, convergence with the majority group may lag due to a lower pace of decline for the minority. The differences within time periods are assumed to reflect the power arrangement in the stratification system involving minority and majority relations. Concerning the French, British and Native (Aboriginal) indigenous populations in Canada, historical and contemporary evidence suggests that two of these groups have occupied a minority status in the sociological sense. In the case of Natives and the French, Lieberson's (1961:904) work on race and ethnic relations is pertinent:

> "...when two populations begin to occupy the same habitat but do not share a single order, each group endeavours to maintain the political and economic conditions that are at least compatible with the institutions existing before contact. These conditions for the maintenance of institutions cannot only differ for the two groups in contact, but are often conflicting. European contacts with the American Indian, for example, led to the decimation of the latter's sources of sustenance and disrupted religious and tribal forms of

> organizations. With respect to a population's efforts to maintain its social institutions, we may therefore assume that the presence of another ethnic group is an important part of the environment. Further, if groups in contact differ in their capacity to impose changes on the other group, then we may expect to find one group 'superordinate' and the other population 'subordinate' in maintaining or developing a suitable environment".

The initial culture contact between European settlers and the Aboriginal People resulted in superordination on the part of the new immigrants and subordination of the Natives. Two of the most serious consequences arising out of this historical fact are the social and economic segregation of Aboriginals and their greater risks of morbidity and mortality. Regional studies of Native Indians in Canada demonstrate that in comparison to the general population, they suffer significantly higher rates of mortality associated with causes that may be viewed as reflecting the social psychological residues of the initial contact discussed by Lieberson (1961), namely accidents, violence and alcohol related deaths (Jarvis and Boldt, 1982; Millar, 1982).

The French case follows a similar pattern, but differs significantly from the Aboriginal case. In the initial stages of Canadian history they were part of the superordinate group along with the British. However, the historical and political events that ensued led to the eventual subordination of French culture to the superordinate British group. Much has changed in recent decades, however: Canada has witnessed the French population move from a subordinate minority in Quebec (where over 80% of the French reside), to a position of majority status in that province following the rise to power of the Partie Quebecois in 1976. Nevertheless, the long term consequences of minority status will probably take one or two generations to eradicate completely. For the purposes of this study, the available data encompasses only the three census periods 1951 to 1971, thus failing to capture the recent political changes in Quebec society. In the framework of this analysis both the French and the

Aboriginals are defined as minority groups; that is, they are "...self-conscious social aggregates, with hereditary membership and a high degree of endogamy, which are subject to political, or economic, or social discrimination by a dominant segment of an environing political society" (Williams, 1964:304). This definition applies to the French and Aboriginals, in that both groups have been subject to political, economic, and social discrimination historically. It also serves to define the more dominant segment of Canadian society, the British -- a view that is consistent with the work of Porter (1965) and others (e.g., Clement, 1975). Due to their more advantaged position, it is hypothesized that the British will show the lowest death rates in contrast to the French and Native Peoples.

Data Evaluation and Methods of Analysis

The mortality data were taken from the mortality data base created by Statistics Canada (Smith and Newcombe, 1980). The file contains all reported deaths in Canada since 1950; the total number of cases exceeds 4,000,000. The variables ethnic origin and place of birth (nativity) have been recorded along with the decendent's demographic characteristics such as age, sex, marital status, etc., and relevant medical information (cause of death). One of the limitations of the data set is that since 1973 the ethnic variable has been discontinued, thus explaining the terminal period of analysis being 1971. A more serious aspect of the data pertains to the problem of missing information with regard to ethnic origin on the one hand, and place of birth on the other. It was discovered that the coding of these two variables has tended to be incomplete at certain points in time. The 1950-52 period posed no major problem as there were few missing cases, but in the interval 1960 to 1962 (a period surrounding the 1961 census), the proportion of available cases that had

nativity as an identifying characteristic was less than one percent. During the same period, the ethnic variable was more complete; its coding fluctuated from 90 percent in 1960, to 57 percent in 1962. Due to this problem, 1963-65 deaths are used instead of 1960-62. Within the 1970-72 interval the nativity variable posed no major problem as it was coded for 98 percent of the cases, but concerning ethnicity, however, significant undercoding was detected. Given such data problems, one may question the utility of proceeding with the study. Surely, there are no ideal solutions. It was felt that regardless of its limitations the available data could be utilized in an efficaceous manner to study a phenomenon that has received only a limited degree of attention in the context of Canada.

The solution applied involved the apportionment of the unknown cases on the basis of the group's age-sex compositions in conjunction with their known distributions of deaths.[1] The deaths were first partitioned into five categories of ethnicity-nativity: British native-born, French native-born, Native Indians, other Native-born, and "other". This classification was further broken down by age, sex and cause of death (four broad causes) and time period. The unknown cases -- broken down by age, sex, cause, and time -- were apportioned to the ethnic specific partitions above. The use of the age-sex distributions along with the known distribution of deaths for each ethnic group was restricted such that one-half of the missing cases were determined by the populations' age-sex structures and the remaining half of the unknown cases was determined by the ethnic distribution of known deaths. Had we relied on one or the other distribution alone, bias would have been introduced in that sole reliance on the age composition approach would augment the age effect on the odds of death, while utilization of only the known distribution of deaths would inflate the influence of ethnic group membership on mortality.[2]

The population age-sex structures served as the denominators for the computation of rates. They were derived from published census tabulations on ethnic origin broken down by age and sex, and place of birth by age and sex, separately. The methodology involved in partitioning the foreign-born components from the French and the British respectively is given in the Appendix. The rationale for focussing on the indigenous elements of the subgroups was dictated by the fact that in a preliminary examination of the data it was discovered that substantial mortality differences exist between the native and foreign-born; therefore, it was decided to exclude foreigners of French and British backgrounds from the analysis. The Aboriginal age-sex composition did not require the separation of foreigners from their overall age-sex specific totals, but due to the Canadian census's inclusion of Metis, Inuit, and Eskimos, in the published census tablulations of "Native Indians", the mortality data for these specific groups had to be collapsed to be consistent with this constraint, thus justifying the usage of the term Aboriginals to designate these four Native subgrouups. Consequently, a separate study of the Native subpopulations is not possible. Demographers in Canada have expressed concern that the census figures for Natives may represent an undercount (Piche and George, 1973). The available census figures were inspected and it was discovered that some undercounting of the age-sex distribution exist and appropriate adjustments were applied.[3]

Statistical Analysis

The hypotheses developed earlier require the application of a multivariate methodology appropriate for the analysis of the conditional odds of dying. Logit modelling is the method adopted (Goodman, 1972; Feinberg, 1978). The logit regression model in multiplicative terms is expressed as follows:

$$\widehat{DR}_{ijk\cdots n} = \eta \tau_i^A \tau_j^B \tau_k^C \cdots \tau_n^N$$

Thus, the expected death rate ($\widehat{DR}_{ijk\ldots n}$) for age group i, sex j and ethnic population k, is a multiplicative function of the intercept η, and effect parameters τ, for categories of variables A, B and C to N. This equation can be rewritten in additive form by taking the natural logrithm of both sides of the formula:

$$L_g \widehat{DR}_{ijk\cdots n} = \alpha + B_i^A + B_j^B + B_k^C + \cdots B_n^N$$

The τ, η, α and B parameters are derived by maximum likelihood estimation (Feinberg, 1978). As in regression, the equation may be used to predict the relative odds of death (the adjusted mortality rate) for the groups in this study.

Results

Table 1 displays observed and adjusted death rates among the French, British and Aboriginals broken down by sex and period, as are total death rates. Table 2 shows the logit equations used to derive the predicted rates in Table 1. Within each subpopulation, death rates are higher for males than for females -- a pattern consistent with general knowledge of the sex differential in mortality. Over time, the British have enjoyed the lowest risks of death while the Aboriginals (Natives) have been the most disadvantaged. In the three-year period around the 1951 census the distance between the Native Indians' rates and the British was astounding. The adjusted death rate (once age, sex and cause are taken into account) for the British was 76.2 per 10,000 population while for the Natives it was 191.1 -- a difference of 115 deaths per 10,000 population.

By comparison, the French, in relation to the British, had an excess mortality of 15 per 10,000 population. During the mid 1960s all three groups witnessed significant improvements in their chances of survival, but the gap in the mortality differential widened for the French to a difference of 18 excess deaths per 10,000 population. For the Natives, the difference narrowed to an excess of 75 deaths per 10,000 population. In the early part of the 1970s the groups shared further declines, but the pace of change was not shared equally. The excess mortality of the Aboriginal People was reduced to 31.6 per 10,000 population, whereas the French experienced a reduction in their excess mortality of 25 deaths per 10,000, which constitutes a widening of the differential relative to their 1964 gap vis-a-vis the British.

The logit parameters for the odds in Table 2 may be interpreted as independent effects on the expected death rate. Thus, age, sex and period show a predictable pattern consistent with previous empirical knowledge: age has a J-pattern of mortality; males experience greater risks of death; and time is inversely related to the odds. Concerning cause of death, "other" and cardiovascular diseases are the leading causes followed by neoplasms and accidents-violence, respectively. A close inspection of the net pattern of age specific mortality among the three subgroups demonstrates the disadvantage of the Natives within the ages of zero to approximately 50, at which point a crossover effect is identified. The French suffer intermediate odds from age zero to approximately age 15, at which point the British-French differences become small, and some convergence occurs, followed by a slight crossover between ages 25 and 35. Beyond age 35, there is another crossover, but it is in favour of the French.

Table 1. Observed and Adjusted Death Rates Among the French, British and Aboriginal Indigenous Populations of Canada, 1950-52 to 1970-72 (Rates per 10,000 Population)

Period and Population	Observed			Adjusted*		
	Sex			Sex		
	Male	Female	TOTAL	Male	Female	TOTAL
1950-52						
FRENCH	90.0	69.7	79.9	100.6	80.9	90.8
BRITISH	83.4	69.2	76.3	84.4	59.2	76.2
ABORIGINAL	207.4	160.2	184.7	219.1	163.1	191.1
1963-65						
FRENCH	91.6	66.4	79.0	94.2	62.3	78.3
BRITISH	70.8	51.3	61.1	74.2	46.4	60.3
ABORIGINAL	128.6	99.7	114.2	155.7	115.2	135.0
1970-72						
FRENCH	93.5	65.9	79.7	92.3	61.0	76.7
BRITISH	63.0	42.9	53.0	62.9	40.0	51.5
ABORIGINAL	72.4	54.1	63.3	95.3	70.9	83.1

Adjusted death rates were derived with the equations in Table 2.

The crossover phenomenon has been studied in some detail in connection with blacks and whites in the United States (Manton et al., 1979), and across various societies (Nam et al., 1978). Our explanation for its occurrence among Natives is the same as that which others have advanced in different contexts: Its occurrence is due to a selection effect favouring persons at older ages, because presumably, if members of deprived minorities are able to survive those segments of their life cycles during infancy, youth and young adulthood, where the probabilities of death are much greater for the minority as a whole, their force of mortality at older ages is relatively slower.

Predicted cause specific rates by period, sex and ethnic group are exhibited in Table 3. Cardiovascular diseases and neoplasms among the French and British groups have accounted for a greater number of deaths than accidents and violence.[4] For Aboriginals, "other" causes and accidents-violence respectively, have been the leading causes of death over time. This pattern of mortality reflects the notion that the more advantaged populations tend to experience a cause of death structure associated with degenerative and life style related complications, whereas the less advantaged populations tend to suffer greater risks from other complications such as infectious and parasitic diseases and less so from degenerative sources of death. The experience of the three groups falls somewhat within this generalization (Omran, 1971). The Native Peoples are a more disadvantaged group and therefore lead in "other" causes (encompassing infectious and parasitic diseases). Consequently, they are less likely to suffer high risks of death from neoplasms and cardiovascular complications in relation to the British and French populations. The Aboriginals deviate from the general expectation however, in that their rates of mortality due to accidents-violence are not typical of a less advanced and

Table 2. Additive and Multiplicative Logit Regression Analyses of the Odds of Dying for the French, British, and Aboriginal Indigenous Populations of Canada [Main Effects Model].

Effects	FRENCH			BRITISH			NATIVE-INDIAN		
	α	β	η τ	α	β	η τ	α	β	η τ
Age (A)	-6.488		.039	-6.763		.034	-6.115		.047
0-4		.070	1.036		-.078	.961		.740	1.452
5-9		-2.322	.313		-2.480	.289		-1.818	.403
10-14		-2.620	.270		-2.686	.261		-2.058	.357
15-19		-1.930	.381		-1.886	.389		-1.322	.516
20-24		-1.670	.434		-1.648	.439		-.978	.613
25-29		-1.720	.422		-1.746	.418		-.926	.630
30-34		-1.514	.469		-1.524	.467		-.852	.653
35-39		-1.204	.548		-1.184	.553		-.656	.720
40-44		-.748	.688		-.712	.700		-.550	.759
45-49		-.312	.855		-.270	.870		-.320	.852
50-54		.206	1.108		.206	1.108		-.214	.898
55-59		.632	1.372		.632	1.372		.062	1.032
60-64		1.074	1.711		1.098	1.731		.458	1.257
65-69		1.486	2.102		1.522	2.141		.838	1.521
70-74		1.924	2.616		1.978	2.688		1.194	1.817
75-79		2.402	3.322		2.438	3.382		1.670	2.305
80-84		2.846	4.148		2.886	4.235		2.026	2.754
85+		3.406	5.488		3.456	5.631		2.696	3.850
Sex (S)									
Male		.206	1.109		.234	1.124		.148	1.077
Female		-.206	.902		-.234	.889		-.148	.929
Period (P)									
1950-51		.044	1.025		.216	1.114		.365	1.200
1963-65		-.014	.993		-.024	.988		.059	1.030
1970-71		-.034	.983		-.192	.909		-.426	.808
Cause (C)									
Neoplasms		-.100	.951		-.130	.937		-.994	.608
Cardiovascular		.778	1.476		.978	1.631		-.228	.892
Accidents-Violence		-1.226	.542		-1.152	.562		-.054	.973
Other		.548	1.316		.304	1.164		1.276	1.893
L^2		179,716.50			161,839.25			13,805.85	
DF		408			408			408	
R^2 Analogue (Based on [D][ASPC] as baseline model):		.97			.88			.77	

relatively deprived population; in fact, they are much higher than expected. In less advanced societies (populations), accidents and violence mortality generally account for fewer deaths than is reflected by the experience of Natives in Canada. Thus, this observation does not fit very well with the statements of Omran (1971) and of McKeown et al., (1972) concerning a population's level of socioeconomic development and cause of death structure. Although these authors were concerned with national populations, it would appear that the implications for disadvantaged subpopulations within larger societies ought to be comparable.

Concerning neoplasms, the French have been leading over the other two groups, whereas the British and Natives have been quite similar in their rates. The French have suffered the greatest odds in cardiovascular diseases as well, but the British's levels for this cause of death are significantly above the Aboriginals. The latter group has been documented as having a "style of dying" (Jarvis and Boldt, 1982) that reflects accidents and violence and alcohol related complications as principal causes of death; the data support this notion. The disadvantage of Natives in connection with accidents-violence mortality is in the magnitude of rates that are approximately three to six times greater than French and British groups. With respect to "other" causes the Natives have shown significant declines over time, but wide gaps persist in relation to the British. In a similar way, the British-French differential has favoured the former group.

Table 4 is included to show the relative importance of each cause of death on the overall death rate of each group. The table exhibits the resultant hypothetical death rate for each population given the elimination of a given cause of death from their overall mortality structure once age and sex are taken

Table 3. Predicted Death Rates Due to Four Major Causes of Death for the French, British, and Aboriginal Indigenous Populations of Canada, 1950-51 to 1970-72 (Rates per 10,000 population)

Population by Period	Cause by Sex											
	Neoplasms			Cardiovascular			Accidents-Violence			All Other Causes		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total
1950-52												
FRENCH	17.8	11.8	14.8	43.0	42.8	42.9	5.8	3.8	4.8	34.0	22.5	28.3
BRITISH	15.9	10.0	12.9	48.2	30.2	39.2	5.7	3.6	4.6	24.6	15.4	20.0
ABORIGINAL	14.2	10.6	12.4	30.6	22.8	26.7	36.4	27.1	31.8	137.9	102.6	120.3
1963-65												
FRENCH	16.6	11.0	13.8	40.3	26.6	33.5	5.4	3.6	4.5	31.9	21.1	26.5
BRITISH	10.4	6.5	8.5	31.5	19.7	25.6	3.7	2.3	3.0	16.0	10.0	13.0
ABORIGINAL	10.0	7.5	8.8	21.6	16.1	18.9	25.7	19.1	22.4	97.4	72.5	85.0
1970-72												
FRENCH	16.3	10.8	13.6	39.4	26.0	32.7	5.3	3.5	4.4	31.3	20.7	26.0
BRITISH	8.8	5.5	7.2	26.7	16.7	21.7	3.2	2.0	2.6	13.6	8.5	11.1
ABORIGINAL	6.2	4.6	5.4	13.3	9.9	11.6	15.8	11.8	13.8	60.0	44.6	52.3

*Predicted using equations in Table 2.

into account.[5] Thus, the lower the death rate once a given cause is eliminated, the greater the relative importance of that cause of death in determining the group's current overall mortality. In 1951, for the French, elimination of "other" causes and cardiovascular diseases separately, would have the greatest impacts in lowering their overall mortality, whereas among the British the leading causes tend to be cardiovascular related complications followed by accidents-violence. Among Natives, accidents-violence and cardiovascular diseases have similar impacts on the death rate, but the former cause accounts for slightly more deaths overall. However, their leading cause of death is the "other" diseases category, with the exception that in 1970-72, accidents-violence and cardiovascular complications predominate as the leading sources of their overall mortality. It was determined that in order for Aboriginals to experience the same rates as the British, both accidents-violence and cardiovascular diseases would have to be eliminated simultaneously. (Table not included but available on request). This finding was unexpected: Most researches into Aboriginal mortality in Canada have demonstrated that this population leads in accidents-violence mortality and that such causes account for the majority of deaths within this group (Jarvis and Boldt, 1982; Millar, 1982). The results in Tables 3 and 4 suggest that since 1951, cardiovascular diseases have been accounting for an increasing number of Native deaths, and the differences between accidents-violence and cardiovascular complications have been diminishing, hence accounting for an almost equal share in determining the overall mortality level of the group.

Figure 1 shows the net age patterns of mortality for each cause separately, once all other variables are taken into account. The logit parameters are plotted in order to identify the underlying age pattern of mortality for each

Table 4. Effect of Eliminating a Given Cause of Death on the Expected Death Rate of the French, British and Aboriginal Indigenous Populations of Canada, 1950-52 to 1970-72 (Rates per 10,000 Population)

Period and Population	Expected Death Rate if the Following Cause is Eliminated:							
	Neoplasms		Cardiovascular		Accidents-Violence		All Other	
1950-52								
FRENCH	70.8	(-20)	61.9	(-28.9)	72.8	(-18.0)	39.4	(-51.4)
BRITISH	52.9	(-23.3)	38.8	(-37.4)	39.5	(-36.7)	52.0	(-24.2)
ABORIGINAL	152.4	(-38.7)	131.4	(-59.7)	127.3	(-63.8)	68.4	(-182.7)
1963-65								
FRENCH	66.1	(-12.2)	47.3	(-31.0)	68.1	(-10.2)	49.7	(-28.6)
BRITISH	40.9	(-19.4)	28.6	(-31.7)	41.0	(-19.3)	31.9	(-28.4)
ABORIGINAL	93.6	(-41.4)	77.1	(-57.9)	75.8	(-59.2)	68.1	(-66.9)
1970-72								
FRENCH	61.8	(-14.9)	50.2	(-26.5)	66.5	(-10.2)	48.9	(-27.8)
BRITISH	46.6	(-4.9)	26.7	(-24.8)	34.6	(-16.9)	34.1	(-17.4)
ABORIGINAL	51.7	(-31.4)	42.0	(-41.1)	40.5	(-42.6)	50.2	(-32.9)

NOTE: Reductions in the death rate per 10,000 population are given in parentheses. The negative sign means a reduction effect in the overall expected death rate.

population and to determine how the patterns differ in terms of level, shape and form. Period specific age patterns can be derived by taking into account the effects of time. It was discovered that the levels change in a declining trend for each group, but the shape, form, and relative positions of the groups do not differ significantly from the overall picture in Figure 1. It was therefore decided to not include period specific age patterns of mortality. The figure shows that different patterns are evident due to the varying nature of the causes on the force or mortality. In all cases the Aboriginals have higher odds up to approximately ages 45 or 50, and at later ages they tend to experience a crossover effect (Nam et al., 1978; Manton et al., 1979). The most atypical age pattern is associated with accidents-violence where the crossover occurs at approximately age 65.

The British and French populations have very similar patterns, but some notable differences may be indicated briefly. With regards to two causes, neoplasms and accidents-violence, the British have lower risks from age zero to approximately age 30-35, and at later ages, a reversal occurs; however, it is of a much lower order than that observed for the Natives' crossover effect. Pertaining to cardiovascular deaths, the French have a slight advantage among the young age groups, but the reversal at older ages favours the British. These two populations exhibit a series of slight crossovers in connection with "other" causes; however, at the very young ages the British enjoy a more advantaged position as their odds are slightly below the French. Whether this relationship is due to endogenous features of the French culture or possibly their minority status is not possible to determine with the data available. However, the findings confirm the conclusions derived by Roy (1975) in Quebec that overall, the French suffer higher rates of mortality in comparison to all other ethnic groups in the province.

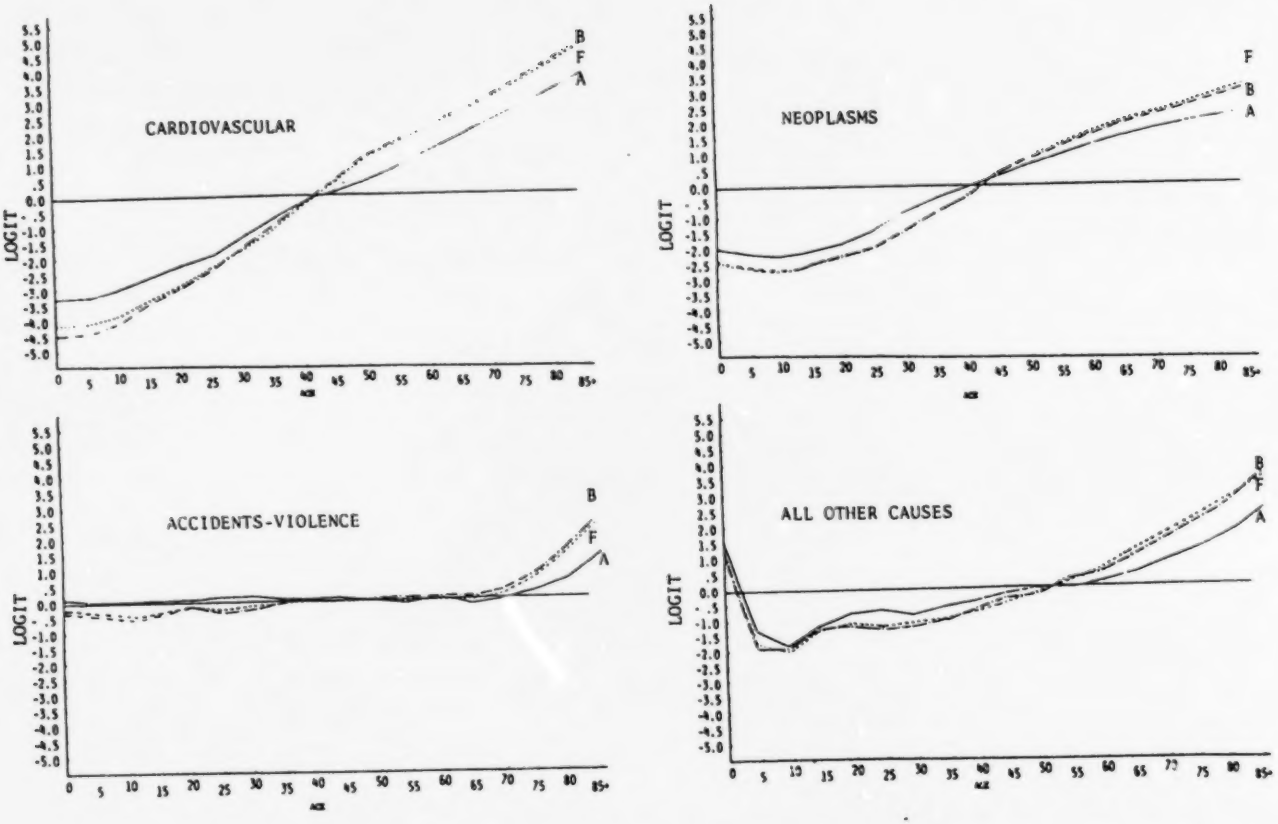

FIGURE 1. NET AGE PATTERNS OF MORTALITY ASSOCIATED WITH FOUR BROAD CAUSES OF DEATH AMONG THE FRENCH, BRITISH, AND ABORIGINAL INDIGENOUS POPULATIONS OF CANADA, 1950-52 TO 1970-72.

These age patterns of mortality confirm our previous observations that the Aboriginal people are the most disadvantaged group in the face of death. The fact that at younger ages they lead in the odds of dying in such causes as neoplasms and cardiovascular diseases, but overall they experience lower rates from these two afflictions relative to British and French groups, was an unexpected finding. Part of the explanation for this rests in the crossover phenomenon; this effect among Natives works to cancel out their higher risks of premature mortality at younger ages. This is something we would not have detected had we failed to examine the age patterns of mortality. In the case of accidents-violence and "other" causes, the impact of the crossover does not lead to a complete cancelling out effect because the phenomenon tends to occur at later ages than is the case with neoplasms and cardiovascular deaths. Moreover, what is shown in Figure 1 is the net effect of age for each group, and it must be recognized that the effect of ethnicity per se, (which partly reflects minority status), is quite powerful tending to actually override the noted crossovers in relation to the group's overall death rate. Further, their higher age specific odds up to middle adulthood is suggestive of the possibility that it is more than a subcultural way of life that accounts for Indians' higher overall mortality rate. Neoplasms (also other causes), are not readily explainable by life style habits; therefore, their mortality experience within the young ages associated with these causes must be due to the influence of exogenous factors in the larger society. On the other hand, the fact that this group leads in accidents-violence mortality (and that cardiovascular complications account for a large number of deaths), is suggestive of endogenous features of the Native People's subculture as well. Accidents and violent deaths are known to be directly related to alcohol consumption and other

dimensions of life experiences (Jarvis and Boldt, 1982). However, this feature of Native culture may not be completely independent of other factors and developments exogenous to the group. The pattern of accidents-violence for Natives is traceable to their social and economic segregation from the main society and the associated social psychological disorganization experienced by members of this group. These effects are difficult to separate empirically, but the Aboriginal experience in the context of Canadian society and North America, is well documented: The Native community has been experiencing the many social, economic and psychological consequences of political and socioeconomic segregation and subordinate status (Lieberson, 1961). It has been shown that members of discriminated minorities often tend to express their frustrations and anger, arising out of their experience of minority status, by engaging in intrapunitive behaviour such as suicide, accidents, and ingroup violence (Simpson and Yinger, 1972). The reasons associated with an increasing importance of cardiovascular diseases for Aboriginals may relate to the general, but gradual, modernizing forces that have been permeating this subpopulation over the last few decades; one of the concommitants of this process is an increase in cardiovascular mortality due to life stresses in the modern society (Crimmins, 1981; Omran, 1971).

Evaluation of Hypotheses

Mortality Assimilation

The assimilation hypothesis posits a convergence in the mortality rates holding all other relevant factors constant. The adjusted death rates presented earlier satisfy this requirement as they were derived by the logit equations for the analysis of conditional risks of death. Figure 2 is a graphic representation of the net rates; it provides a visual test of the mortality

assimilation thesis. As stated earlier, there has been a downward trend (in varying degrees) among the three populations, but the declines have been more precipitous for Natives. Moreover, in the last period of observation the evidence shows that the gap between French and British groups is not narrowing, but is widening slightly. Further evaluation of this effect (Table not included) explains this differential as a function of the small, but increasing effect of time in connection with cardiovascular, neoplasms and accidents-violence French mortality. For the British and Natives, time tends to contribute to a declining impact (in varying degrees) on these cause, of death. These patterns contribute to explaining the general slowing of the French's rate of overall mortality decline over time, but the substantive reasons for this are not known. Our evidence suggests that life stress factors may be important because the time effect acts in such a way as to increase accidents-violence and cardiovascular mortality (two causes assumed to reflect life stresses), while reducing the effect of "other" causes. The overall indication would seem to suggest that had we been able to extend this analysis into the future, further declines would occur for the Aboriginals, and they would probably converge with the French rates, but a significant gap would most likely prevail for these two groups in relation to the British.

The Minority Status Effect

The fact that at each period of observation a substantial difference in net mortality rates has existed provides support for the relevance of subgroup membership in accounting for inequalities in the force of mortality. An independent effect of ethnic membership given that time, age, sex and cause of death are statistically controlled for, would provide support for the minority

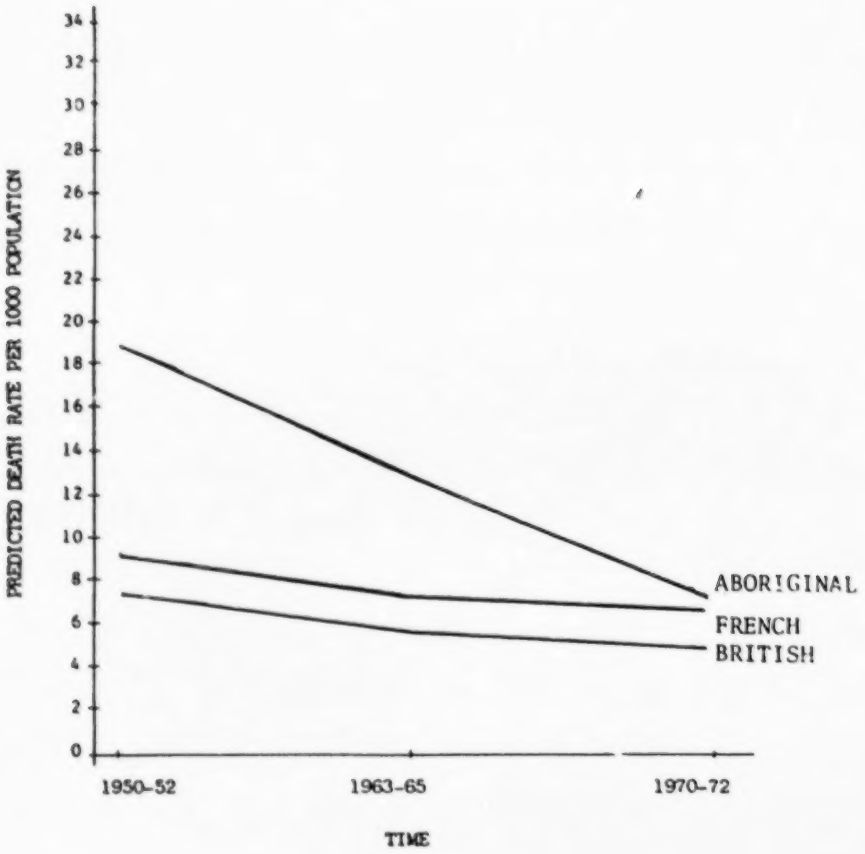

FIGURE 2. PATTERNS OF DECLINE IN THE ADJUSTED DEATH RATE OF FRENCH, BRITISH, AND ABORIGINAL POPULATIONS OF CANADA, 1950-52 TO 1970-72.

status effect on mortality. To evaluate this possibility, a logit regression analysis was computed containing all of the above variables. In Table 5, substantial main effects of ethnicity emerge: Being French multiplies (or adds if working with the additive model), the expected odds of dying by 1.008, whereas belonging to the British multiplies the odds by only .797; and the effect of Aboriginal membership serves to multiply the odds by 1.244. These differences in the ethnic parameters tend to provide support for the minority status hypothesis. Thus, regardless of a general trend toward convergence over time, substantial differentials persist between the three subpopulations. The substantive interpretation of this result is that the differentials arise out of the dynamics of ethnic stratification in Canadian society discussed earlier. Mortality is the most sensitive indicator of life chances (Tumin, 1967), and differences in life chances arise out of social, political and economic inequities in society (Lieberson, 1961).

Ethnicity, Education and Mortality

The foregoing analysis demonstrates that minority status, as reflecting, the accumulated historical experience of prejudice and discrimination, is an important source of mortality inequality. This hypothesis is supported because substantial ethnic main effects remain once age, sex and time are taken into account simultaneously. Thus, the ethnic effect encompasses the influence of group inequality in the stratification system of society. This suggests that if a proxy measure for socioeconomic status were to be introduced in a multivariate analysis, the effect of ethnic membership *per se* ought to disappear. This proposition was tested empirically by utilizing the only available data which would allow such a verification. Unfortunately, the only period for which the

Table 5. Logit Regression Analysis of the Odds of Dying [Main Effects Model].

	Additive Model		Multiplicative Model	
Effects	α	β	η	τ
Age (A)	-4.838		.039	
0-4		.060		1.030
5-9		-2.352		.308
10-14		-2.612		.271
15-19		-1.878		.391
20-24		-1.626		.443
25-29		-1.692		.429
30-34		-1.492		.474
35-39		-1.180		.554
40-44		-.734		.693
45-49		-.302		.860
50-54		.182		1.095
55-59		.606		1.354
60-64		1.060		1.698
65-69		1.478		2.093
70-74		1.916		2.608
75-79		2.378		3.283
80-84		2.818		4.093
85+		3.374		5.401
Sex (S)				
Male		.218		1.116
Female		-.218		.896
Period (P)				
1950-51		.144		1.075
1963-65		-.018		.991
1970-71		-.126		.939
Cause (C)				
Neoplasms		-.146		.929
Cardiovascular		.854		1.533
Accident-Violence		-1.194		.560
Other		.452		1.253
Population (E)				
French		.016		1.008
British		-.452		.797
Aboriginal		.436		1.244
L^2			395,140.25	
DF			1,270	
R^2 Analogue			.980	

(Based on [D][ASPCE] as baseline model):

appropriate data are available in Canada, with specific reference to the objectives of this study, is 1971. This kind of analysis is impossible for 1951 and 1961 periods because the appropriate data do not exist.

Public Use Sample data of the 1971 Census of Canada was relied on to compute group age-sex specific education levels. The education variable was then appended to the age-sex specific mortality rates of the three ethnic groups. This procedure allowed for a multivariate analysis of the relationship between mortality, age, sex, education and ethnicity for the 1971 period. An important assumption of this approach is that for the three subgroups, the education levels of their decedents are the same as their alive counterparts which gave rise to the observed education levels in the census. A further assumption is that within age-sex groupings, the relationship between education and the risk of dying is constant. These are not unreasonable assumptions in the context of ecological types of analyses where individual level data are not readily available or possible to collect.

The results of a least squares multiple regression analysis are presented in Table 6. The table shows the equations specific to the total death rate, neoplasm, cardiovascular, accidents-violence, and "other" causes of death. Even after the effects of age, sex and education are taken into account, the impact of ethnic membership is statistically significant and is in the expected direction; that is, in relation to the British, the influence of Native Indian or French subgroup membership increases the relative mortality risks of the latter two groups, but generally more so for the Aboriginals.

The implications of the regression analyses with respect to minority status and mortality are two: 1) although education, as a proxy for socioeconomic position is controlled for statistically, the effect of ethnic membership

Table 6. Multiple Regression Analyses of the Total Death Rate and Four Cause Specific Death Rates, Canada 1970-71

Effects		TOTAL $Lg(M_x.1000)$ ($\bar{x}$=1.130;SD=2.00)	NEOPLASMS $Lg(M_x.1000)$ ($\bar{x}$=.914;SD=2.06)	CARDIOVASCULAR $Lg(M_x.1000)$ ($\bar{x}$=1.134;SD=2.78)	ACCIDENTS-VIOLENCE $Lg(M_x.1000)$ ($\bar{x}$=.612;SD=1.11)	ALL OTHER $Lg(M_x.1000)$ ($\bar{x}$=1.85;SD=1.47)
	r	.677	.860	.831	.488	.563
Lg(Age)	b	1.760132*	2.303735*	3.007000*	.6877752*	1.083202*
I=0-4	B	.685	.877	.847	.486	.577
18=85+	F	(416.64)	(437.89)	(310.95)	(74.83)	(62.14)
(x=2.02;SD=.780)						
	r	.124	.050	.096	.366	.152
Sex	b	.4608675*	.1271902	.4313058**	.8109709*	.4018360*
I=M	B	.115	.031	.078	.368	.137
0=F	F	(11.75)	(0.55)	(2.63)	(42.81)	(3.52)
(x=.50)						
(SD=.50)						
	r	.052	.134	.048	-.084	.069
French	b	.6548013*	.9323211*	1.199444*	.5782384*	.8510562*
I=French	B	.154	.215	.204	.247	.274
0=British	F	(15.84)	(18.92)	(11.84)	(10.94)	(10.12)
(x=.33;SD=.33)						
	r	.116	-.037	.050	.516	.202
Aboriginal	b	.7333444*	.3375842**	1.484214*	1.490177*	.6927535*
I=NI	B	.173	-.078	.253	.638	.223
0=British	F	(19.71)	(2.21)	(15.90)	(92.32)	(5.97)
(x=.33;SD=.33)						
	r	-.114	-.117	-.118	-.042	-.206
Lg(Educat.)	b	-.6279814*	-1.354527*	-1.729052*	.0673170	-.7590531*
(x=1.89)	B	-.139	-.292	-.276	-.027	-.229
(SD=.44)	F	(16.59)	(34.41)	(24.80)	(0.17)	(6.94)
Intercept		-1.941340	-1.451978	-2.796061	-2.001083	0.3724951
R^2		.522	.822	.766	.679	.457

*p<.01
**p<.05

NOTE: The overall group specific average education was assigned to their respective 0-4 age groups; $L_gM_x.1000$ refers to the logrithm of the death rate per 1000 population.

persists on general and cause specific mortality, suggesting that socioeconomic disparities in society do not totally explain ethnic groups inequities in the face of mortality; 2) given that the differential in socioeconomic status has been controlled for, the main effect of subgroup membership must encompass sources of mortality differences which go beyond socioeconomic inequalities. Unfortunately, the necessary data to ascertain such potential source are not, and possibly, will never become readily available; however, consistent with our earlier elaboration, the ethnic effects may reflect historical elements of prejudice and discrimination. For example, the Aboriginals' higher mortality levels are partly traceable to their geographic and social isolation from the major urban centres where good health care facilities are available. This kind of segregation is a direct outcome of discrimination that has developed historically in the context of race and ethnic relations mentioned by Lieberson (1961). Of course, segregation may not be the only component of an historical experience of discrimination that is captured by an ethnic effect. There may be other aspects of minority status, subcultural and/or structural as sources of inequality in death. Cultural differences in norms about life styles, the perception and definition of illness, the response to the sick role, and the response to illness, are all specific elements of subculture which determine morbidity and mortality levels among subpopulations (Zola, 1966; Suchman, 1964; Zborowsky, 1952). These kinds of subcultural sources of mortality may or may not be independent of a historical experience of prejudice and discrimination. Often, subcultural norms develop as a response to prejudice and discrimination, in other instances they develop independently. This possible confounding of structural and subcultural sources of mortality make a definitive statement about the independent role of ethnicity for the French and Native Indians very difficult. What has been attempted here is to demonstrate that minority status,

as reflected in an independent ethnic effect, is a relevant source of mortality differences among three of Canada's ethnic subpopulations. In connection with this, structural inequalities are assumed to account for a significant portion of mortality differentials. However, the possible role of subculture cannot be overlooked, and ought to be investigated in subsequent research. The problem is, of course, accessibility to the appropriate data to do so. The inaccessibility of the necessary data and the general lack of specific study in this particular aspect of mortality analysis, ought to make the present research a welcomed contribution to this area of investigation even though it is far from providing a definitive statement, and at the same time, leaves many unanswered questions pertaining to ethnicity and mortality. We attempted to utilize the available statistical data sources, although deficient in some respects, to provide an empirical inquiry into a generally unexplored aspect of Canadian mortality. (See footnotes and Appendix for a more complete elaboration of data problems and solutions).[6]

Conclusion

This study investigated the mortality differences, general and cause specific, among three important subpopulations in Canada (the Aboriginals and the two "founding" groups, the French and British). In this regard the analysis makes an important contribution to the sociology of race and ethnic relations while at the same time it expands our knowledge of one aspect of the social demography of the three ethnic groups -- their mortality experience. Although the focus of this study is on Canada, the hypotheses developed and the principles implied are applicable to other societies as well. In the United States and in the United Kingdom for example, a continuing concern among sociologists is to explain the observed mortality differentials among minority

populations and the sociological antecedents responsible for the inequalities in mortality (e.g., Markides, 1983; Bean and Friesbie, 1978; Coleman, 1982). Usually, the analyses are confined to a description of the differentials and not on the evaluation of competing hypotheses. A well formulated theoretical framework is still lacking. A fruitful starting point is the incorporation of stratification principles (as done here), to formulate hypotheses about the relationship between minority status and mortality. A more complete specification, evaluation, and quantification of endogenous and exogenous components of subgroup mortality would prove to be important developments as well. There is need to separate the independent effects of these two sources of mortality to ascertain the relevance of subculture and structural discrimination. Moreover, minorities differ with regard to socioeconomic status, and socioeconomic status may interact with subcultural values and norms to create certain life styles that may be either detrimental or beneficial in terms of longevity and survival.

The findings of this research establish a clear relationship between ethnic origin, minority status and mortality. It is hoped that the present inquiry will prove to be an important contribution to the social demography and ethnic minorities in advanced societies, and that it will stimulate further empirical and theoreetical effort in this area of investigation.

FOOTNOTES

1 The proportion of missing observations has varied as follows:

	(% missing)		
	1950-52	1963-65	1970-72
MALE	3.03	23.72	24.58
FEMALE	2.20	25.32	24.03
DEATHS RECORDED			
MALE	217,085	260,514	280,206
FEMALE	162,467	184,095	199,721
TOTAL	379,552	444,609	479,927

In formal terms, the method of apportionment is as follows (not considering cause of death for the purposes of explanation

$$\hat{D}_{ijk}^{ty} = \sum_{\substack{i=0-4 \\ j=1 \\ k=1}}^{\substack{i=85+ \\ j=2 \\ k=5}} \left[\left(\frac{A_{ijk}^{ty}}{\Sigma A_{jk}^{ty}} \right) \cdot \left(\frac{D_{ij}^{u\,ty}}{2} \right) + \left(\frac{D_{ijk}^{x\,ty}}{\Sigma D_{jk}^{x\,ty}} \right) \cdot \left(\frac{D_{ij}^{u\,ty}}{2} \right) \right]$$

where:

$\hat{D}_{ijk}^{ty}$ = the adjusted deaths after apportionment for time period y, age i, sex j, and subpopulation k;

A_{ijk}^{ty} = the number of persons alive in the age group i, for sex j and subpopulation k;

ΣA_{jk}^{ty} = the total number of people alive at time period y, within each sex group j for subpopulation k;

$D_{ij}^{u\,ty}$ = the unknown number of deaths at time period y, for age group i and sex j;

$D_{ijk}^{x\,ty}$ = the distribution of known deaths at time period y, for age group i, sex j, and subpopulation k;

$\Sigma D_{jk}^{x\,ty}$ = the total number of people alive at time period y, within each sex group j, for subpopulation k.

2 The age-sex structures used in this study were derived by subtracting the foreign-born from the ethnic distributions corresponding to the appropriate groups in this analysis. For example, the British native-born age-sex distribution was obtained by subtracting British-foreign-born from British ethnic origin within categories of age and sex. The assumption is that in the census all British foreign-born state themselves as British ethnicity. To the extent that some people of British origin fail to say so on the census, the procedure reflects some degree of bias. The problem is that there is no way to check for this possibility. If this discrepancy does occur, it is assumed to be minor. The British have little reason to not identify themselves as British as they are the dominant group in Canada. The same interpretation may be given for the French ethnic group. Although there is evidence of French linguistic losses to the British in terms of language of the home and mother tongue, there is no evidence to suggest that people of French origin report their ethnicity as something other than French. Overall, however, the definition of ethnic origin in the census may cause some concern because prior to the 1981 census ethnic origin is based on tracing one's lineage through the male side only. No adjustments for this fact were made as the necessary information to do so is not available.

3 The censuses of 1951, 1961 and 1971 show Aboriginal males to be in excess over females at about ages 30 and above. Given our general knowledge of the sex differential in mortality, which favours females, and the sparse publications concerning Natives' mortality, the figures cannot be assumed correct. Before introducing further speculations on this matter let us examine the actual sex ratios. The table below shows sex ratios based on three census years, 1951, 1961 and 1971; also the 1964 ratios based on interpolated figures.

	YEAR			
Age	1951	1961	1964	1971
0-4	101.0	101.2	101.4	101.7
5-9	99.8	102.5	101.4	99.6
10-14	96.8	103.4	103.5	103.6
15-19	97.2	100.2	99.3	98.0
20-24	102.6	94.4	96.0	98.3
25-29	99.4	97.4	97.2	96.8
30-34	106.1	104.6	99.9	92.4
35-39	109.4	99.5	99.2	98.7
40-44	115.5	108.4	106.9	104.6
45-49	116.0	113.8	106.9	96.4
50-54	117.5	117.9	115.0	110.0
55-59	127.1	116.8	115.6	113.7
60-64	124.0	123.3	122.7	121.6
65-69	121.2	117.1	117.5	118.2
70-74	110.9	127.6	124.7	119.7
75-79	104.5	111.0	112.6	115.5
80-84	92.1	96.6	106.0	125.5
85+	74.2	81.5	154.9	93.6
TOTAL	103.7	103.2	102.6	101.2

Assuming that mortality favours females, particularly at the ages beyond 30, we would expect more females than males. In fact, available life tables for the registred Native population (which exclude Metis, Innuit, Eskimos) (Statistics Canada, 1960-64 Natives Life Tables), support this contention. A most probable cause of this imbalance may be due to the fact that the rate of exogamy among female Native Indians is considerably higher than the males. Moreover, women who marry non-Native males are by law considered non-Native. This being the case, it is likely that women fitting this category through out-marriage define themselves as being something other than Indian on the census ethnic question. This would explain the anomaly reported in connection with female undernumeration at ages 30 and above. The table below displays statistics on exogamy among registred Natives. The figures denote that a considerably higher proportion of women marry outside their Native Indian group than is the case for males, a pattern which has remained consistent over time.

	YEAR (% outmarriages)							
SEX	1965	1966	1967	1968	1969	1970	1971	1972
MALE	12.7	15.7	17.3	19.6	16.9	17.9	19.4	18.7
FEMALE	22.2	30.0	30.2	29.9	21.1	25.8	21.7	22.7

SOURCE: Calculated from Statistics Provided by Dept. of Indian and National Affairs.

Assuming that Native deaths are registered accurately regardless of their legal status (registred or non registred), death rates calculated with the unadjusted age figures (denominators) would derive biased results. The rates would tend to be lower among males in relation to females, an outcome which would run counter to reality. For all practical purposes it became necessary to inflate the age figures for Native females aged 30 and above.

The method chosen involved the application of Indian life table stationary population sex ratios. Age-sex ratios were calculated first by utilizing the stationary population (Lx in the life tables) from the 1961-62, 1963-64 and 1967-68 Indian life tables: the ratios and stationary populations are recorded in the table below.

1951**		1961-62 STATIONARY POPULATION			1963-64 STATIONARY POPULATION			1967-68 STATIONARY POPULATION		
AGE	SEX RATIO	M	F	SEX RATIO*	M	F	SEX RATIO*	M	F	SEX RATIO*
0-4	103.5	455017	461755	103.5	458738	468347	102.8	470245	476406	103.6
5-9	103.5	443479	450091	103.5	447671	458482	102.5	462981	470155	103.4
10-14	103.3	440325	447539	103.3	444537	456320	102.3	459744	468024	103.1
15-19	103.0	436046	444626	103.0	440221	453233	102.0	454665	465407	102.6
20-24	102.0	428044	440375	102.0	431524	448242	101.0	444085	460622	101.2
25-29	100.5	416254	434939	100.5	421844	443298	99.9	430432	453726	99.6
30-34	99.3	403953	426908	99.3	411378	436562	98.9	416482	444670	98.3

35-39	99.4	393728	415859	99.4	397125	426035	97.9	402388	432331	97.7
40-44	99.7	383793	404297	99.7	382782	414309	97.0	386761	418572	97.0
45-49	99.2	370795	392561	99.2	368095	398901	96.9	368733	404609	95.7
50-54	98.6	355072	378164	98.6	350667	380293	96.8	347872	386609	94.5
55-59	97.6	334401	359643	97.6	330479	358201	96.9	322985	362231	93.6
60-64	96.0	305921	334355	96.0	303675	327143	97.5	291506	333475	91.5
65-69	95.0	271638	300397	95.0	264875	290509	95.7	252853	301723	88.0
70-74	94.5	226657	251781	94.5	215349	248428	91.0	206457	259818	83.7
75-79	90.5	167368	194167	90.5	159745	191739	87.5	149886	208445	75.5
80-84	83.8	103934	130146	83.8	102135	129007	83.1	97856	147426	70.0
85+	66.6	105323	106008	66.6	113613	139472	85.5	91383	151706	63.5

*Sex ratio from life table Stable Population M/F x 1.05

**Sex ratios are assumed to be the same as 1961-62; life tables for 1951 not available.

The actual age figures were adjusted with the use of the formula:

$$p_F^x = \frac{M_x}{F_x} \Big/ \left(\frac{M_{sp}^x}{F_{sp}^x} \cdot 1.05\right) \cdot A_f^x$$

where:

p_F^x = adjusted female figure in age group x;

$\frac{M_x}{F^x}$ = actual sex ratio based on census figures for age group x;

$\frac{M_{sp}^x}{F_{sp}^x}$ = stable population sex ratio for age group x;

A_f^x = actual census figure for females in age group x; 1.05 is the universal sex ratio.

The formula inflates the actual age figures from the census so that the adjusted results would produce a new sex ratio which conforms to the stable population sex ratios. The assumption inherent in this approach is that sex ratios of the life table stable population are a true representation of the actual Aboriginals sex ratios. The adjusted female figures for the periods of interest are displayed below.

AGE	YEAR 1951	1961	1964	1971
30-34	4854	6233*	----	----
35-39	4404	5066*	----	----
40-44	3968	4390	5095	6460*
45-49	3310	3973	4418	5276*
50-54	3062	3543	3880	4600
55-59	2394	2853	3200	4108
60-64	1950	2640	2815	3536
65-69	1580	1885	2217	3030
70-74	1372	1535	1731	2245
75-79	850	989	1122	1570
80-84	504	613	676	980
85+	320	476	442	635

* Original figure retained
- no adjustment necessary

[4] Originally, it was attempted to use Preston and colleague's 12-cause classification system. This proved unfeasible due to the missing cases problems discussed in the text. Below are the Preston groups and the four-cause classification adopted here.

Preston et al., (1972) Categories	ICDA Detailed List 6th and 7th Revisions	Study Categories
1. Respiratory	001-008	Other Causes
2. Infectious Diseases	010-138	
3. Malignant and Benign Neoplasms	140-239	Neoplasms
4. Cardiovascular Diseases (Circulatory and Cerebrovascular)	330-334, 400-468	Cardiovascular
5. Influenza, Pneunomia Bronchitis	480-502	Other Causes
6. Diarrhea, Gastratis, Enteritis	543,571,572	
7. Certain Degenerative Diseases (Nephritis, Cirrhosis of Liver, Ulcers of Stomach and Duodenum, Diabetes)	260;540;541;581; 590-594	
8. Complications of Pregnancy	640-689	
9. Certain Diseases of Infancy	760-776	

10. Motor Vehicle Accidents	E810-E835	Accidents-Violence
11. Other Accidents and Violence	E800-E802;E840-E999	
12. All Other and Unknown Causes		Other Causes

5 This methodology is similar to decrement life table analysis (see Elandt-Johnson and Johnson, 1981, Survival Models and Data Analysis, New York: Wiley; pp. 294-322). The question one is interested in asking is: what would be the death rate if a certain disease were eliminated as a cause of death? The usual approach is to answer this question by relying on multiple decrement life tables. In this study, the approach is similar, but it differs in that life tables are not relied on, and secondly, we are employing a multivariate model to control for competing causes of death simultaneously. The elimination of a given cause was accomplished by using models of quasi-independence with structural zeros assigned to the cells in the multidimensional table corresponding to the cause being eliminated. Executing this procedure, the death rate is computed for the remaining causes in the analysis, and the difference between the two expected death rates is the effect of the eliminated cause in accounting for the overall expected death rate. For example,

$$\text{Effect of } C_4 = (DR_{C1,C2,C3} - DR_{C1,C2,C3,C4}).$$

6 The Demography Division at Statistics Canada is currently involved in a massive project to evaluate and adjust data for the registred Native Indian population of Canada. Their concerns differ from the object of this study in that their main objectives are to develop projections for this group, which is only one of the several Aboriginal groups in Canada. Moreover, their principle goal is methodological in nature, ours is primarily substantive.

APPENDIX

DERIVING THE FRENCH, BRITISH AND ABORIGINAL NATIVE-BORN AGE-SEX STRUCTURES

1. AGE-SEX COMPOSITIONS FOR 1951

The 1951 Census provides a breakdown of Canada's age-sex distribution in five year age groups (0-4 to 95+). The data is partitioned on the basis of ethnicity. A separate tabulation contains the same kind of information classified by place of birth (e.g., Canada by province; United Kingdom, United States; Germany; Italy; Poland; Russia; Scandinavia; Asia; Other).

British Native-Born

This group was obtained by subtracting the age-sex specific figures of British foreigners (Table 10, Volume II) from the British Ethnicity figures by age and sex (Table 4, Volume II). It is assumed that the ethnic data contain both native and foreign-born persons of British origin and that the difference between ethnicity and foreign-born figures reflect British persons born in Canada. The British group contains England-Wales, Scotland, and Ireland.

French Native-Born

A similar approach was taken as that described for the British utilizing the same sources of information. The major difference was that the census tables do not contain the French foreign-born into its age breakdown. Totals by sex were available, however. In order to derive the age-sex distribution of French foreigners the age-sex composition (proportions) of "Other Europe" was applied to the French foreign-born sex totals.

Once the French foreign-born figures were obtained, calculation of the French native-born by age and sex became a straightforward procedure: the foreigner's age-sex specific figures were subtracted from the French ethnicity age-sex composition.

Two assumptions are worth noting in this regard. first, it is assumed that this approach provides an adequate account of the French native-born population. Secondly, it is implied that French foreigners have an age-sex composition which is the same as the other European foreign-born.

Aboriginals

The figures were taken directly from published census tabulations. It is worth noting that Indians, Eskimos, Innuit, and Metis are included in this population as one group.

The following data sources were utilized:

1951 Census of Canada: General Review and Summary Tables Volume X; (particularly Tables 32, 34 and 35).

1951 Census of Canada: Population Cross-Classification of Characteristics Volume II; (particularly Tables 4, 10 and 40).

2. AGE-SEX COMPOSITIONS FOR 1961

The same procedures described for 1951 were applied to the 1961 Census data. The following census sources were used:

1961 Census of Canada, Population: Single Years of Age. Catalogue 92-543, volume I, Part 2 (particularly Tables 26 and 27);

1961 Census of Canada, Population: Birthplace and Citizenship by Age Groups. Catalogue 92-555, Volume I, Part 3 (particularly Table 89);

1961 Census of Canada, Population: Ethnic Groups by Age Groups. Catalogue 92-553, Volume I, Part 3 (particularly Table 81);

1961 Census of Canada, Population: Characteristics of Immigrants. Catalogue 92-562, Volume I, Part 3 (particularly Tables 124 and 125);

1961 Census of Canada, Population: Age Groups. Catalogue 92-542, Volume I, Part 2 (particularly Table 20).

3. AGE-SEX COMPOSITIONS FOR 1971

Essentially the same procedures as described for the previous two census periods were applied to the 1971 data. Some differences were observed, however. They will be noted below.

British Foreign-Born

In 1971, published census tabulations for the British omitted Ireland from this group's foreign-born population. since Ireland was included in previous censuses, it was decided to use the Public Use Sample Tapes of the 1971 census to obtain an estimate of the Irish foreign-born by age and sex. When this was derived, the figures were then added to the British foreign-born. Subsequently, these were subtracted from the British ethnicity age-sex distribution to obtain the British native-born age-sex composition.

French Foreign-Born

In 1971 the published census tables do not show the desired breakdown for "Other Europe" place of birth (whose age-sex proportionate distribution would have been applied to the sex-specific French foreign-born totals to derive the latter's population composition). The published tabulations, however,

give the appropriate data for "Other Western Europe" foreign-born. Therefore, this category of nativity provided the desired basis for calculating the French foreigners' age-sex composition. By subtraction from the French ethnicity distribution we obtained the French native-born population age-sex structure.

The following data sources were relied on for 1971:

1971 Census of Canada, Population: Age Groups by Birthplace. Catalogue 92-737, Volume 1, Part 4, Bulletin 1.4-9, January, 1974 (particularly Table 25);

1971 Public Use Sample Tapes, 1/100 individual file, 1971 Census of Canada.

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